Application

Of

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For

United States Letters Patent

On

FLAME-RESISTANT SHEET WITH CANDLE WICK SUPPORT

(a) TITLE: FLAME-RESISTANT SHEET WITH CANDLE WICK SUPPORT

(b) CROSS-REFERENCES TO RELATED APPLICATIONS

(Not Applicable)

(c) STATEMENT REGARDING FEDERALLY-SPONSORED RESEARCH AND DEVELOPMENT

(Not Applicable)

(d) Reference to a "Microfiche appendix"

(Not Applicable)

(e) BACKGROUND OF THE INVENTION

1. Field Of The Invention

[0001] This invention relates generally to candles, and more specifically to a structure that reduces some fire hazards associated with burning a freestanding candle.

2. Description Of The Related Art

[0002] The information contained in U.S. Patent No. 5,842,850 to Pappas is incorporated herein by reference.

[0003] A candle is one or more combustible wicks supported by a material that constitutes a fuel, which is solid, semi-solid, or quasi-rigid at room temperature, 68 degrees Fahrenheit to 80 degrees Fahrenheit (20 degrees Celsius to 26 degrees Celsius); it can also contain additives which are used for color, odor, stability, or to modify the burning characteristics; the combined function of which is to sustain a light-producing flame. A candle is freestanding if it is capable of standing upright on its own without requiring a support such as a container or a candle holder. The freestanding candle burns a fuel and has a flame that vaporizes the fuel as capillary action draws the fuel up the wick to the flame. As the fuel is burned, the flame generates heat that melts the fuel into a pool of liquid fuel, which accumulates around the wick in an interior region of the candle.

[0004] A characteristic of the burning freestanding candle is the presence of a peripheral wall around the pool of liquid fuel. The peripheral wall is a barrier that is composed of fuel that remains integral as the candle burns. The wick is positioned within the freestanding candle, spaced from a candle outer surface a distance that promotes the formation of the peripheral wall, as the areas of fuel nearer to the heat of the flame melt into the pool. The pool of liquid fuel is desirably contained in the candle interior from the sides by the peripheral wall, thereby keeping the fuel from draining onto surrounding objects or surfaces.

[0005] The pool of liquid fuel is desirably contained in the candle interior from underneath by a candle floor. The candle floor is the integral fuel underneath the pool of liquid fuel, having a thickness extending upwardly from a bottom surface of the candle to the bottom of the pool of liquid fuel, ending at an interface between the integral fuel and the liquid fuel at the pool bottom. The thickness of the candle floor decreases as the integral fuel is liquefied by the heat and consumed by the flame.

[0006] Freestanding candles often have a wick support to hold the wick, so that the wick does not fall over and ashes properly in the later stages of its operative life. During these stages, the flame and the pool of liquid fuel are usually located deep in the candle interior, and the wick support is often loosely sitting in the pool of liquid fuel on a thin candle floor. The wick support may tip and bring the flame into contact with the liquid fuel, which may be ignited. The liquid fuel can seep under the wick support and melt through any remaining fuel composing the thin candle

floor. The liquid fuel can escape containment, flowing from the candle onto surrounding objects and surfaces, which may absorb the fuel. If the escaped fuel subsequently combusts, then the heat can ignite the fuel-soaked surroundings, and a candle fire results.

[0007] Other fire hazards that involve the formation of the pool of liquid fuel and the peripheral wall may arise as the freestanding candle burns. Factors that can disrupt the ability of the peripheral wall to contain the pool of liquid fuel include air drafts and placement of the candle in a non-vertical position, as well as a tipped wick support. An air draft can cause the flame to lean, which in turn causes the heat from the flame to melt one area of the peripheral wall more than another area. Similarly, non-vertical placement of the candle tilts the candle with respect to the longitudinal axis of the wick. The tilt brings one area of the peripheral wall closer to the flame, and the heat melts the one area of the peripheral wall more than another area. Likewise, a tipped wick support can bring the flame close to the peripheral wall. In all situations the heat from the flame can melt a passage through the peripheral wall, which compromises the structural integrity necessary to contain the pool of liquid fuel.

[0008] If the peripheral wall is not integral, then certain fire hazards arise. As when the thin candle floor melts, the pool of liquid fuel may drain from the candle interior through an opening in the melted peripheral wall, flowing onto and soaking into surrounding objects and the candle-supporting surface. Subsequent combustion of the fuel can ignite the objects or the surface. Additionally, the

draining of liquid fuel from the candle interior results in a sudden decrease in the pool depth. The sudden drop in the pool depth exposes to the flame a portion of the wick that was formerly underneath the pool surface. The flame immediately spreads downwardly and rapidly consumes this unburned, liquid fuel-coated portion of the wick. The result is a dangerously large flame that can melt through the candle floor and large areas of the peripheral wall.

[0009] An additional fire hazard arises due to the sudden draining of liquid fuel from the candle interior. Some wicking can intentionally be manufactured to arc and curl through areas of the flame that oxidize the wick material to ash. Complete disintegration of the wick material results while burning slowly under normal burning conditions, so no wick material accumulates in the candle interior. However, after spreading downwardly due to the sudden draining of liquid fuel from the candle interior, the candle soon returns to normal burning conditions, and the flame becomes smaller at a new point on the wick. Often a top portion of the wick remains partially-combusted and outside of the smaller flame, because the top portion was unable to spend enough time in the oxidizing part of the flame prior to the pool draining. But, now the wick may completely ash at the new point on the wick by the smaller flame, so the top portion can lose support and fall into the pool. Subsequent combustion of the top portion may result in a dangerously large flame that can burn through the candle floor.

[0010] A similar fire hazard arises when combustible materials accumulate in the pool of liquid fuel. Such materials may include an unburned wick portion as

described above, carbon balls, and burned matches. These materials may be ignited by the candle flame, producing a secondary wick that can supplement the flaming wick and make a dangerously large flame. Heat from the flame can melt the candle floor and the peripheral wall, so surrounding objects and surfaces may become exposed to the flame. Also, the flaming secondary wick may float through melted areas of the peripheral wall, off the side of the candle and onto a flammable surface.

[0011] Carbon balls are incomplete products of combustion that have become deposited on the end of the wick, and may include materials such as soot and condensed gas found in smoke. Carbon balls can detach from the wick and fall into the pool of liquid fuel, where they accumulate and become soaked with liquid fuel. The liquid fuel may combust, thereby igniting the carbon balls, which become secondary wicks. Likewise, a burned match in the pool of liquid fuel may become a secondary wick.

[0012] Another fire hazard during the later stages of the operative life of the candle may arise when the pool of liquid fuel becomes shallow. The fuel in the shallow pool can become hot enough to vaporize and no longer needs the wick to burn. This phenomenon is called flash or flashover. Once the upper surface of the pool descends nearly to the bottom of the candle, the fuel can be elevated above its flashpoint temperature, typically about 425 degrees Fahrenheit with conventional, common fuels. During flashover, an ensuing candle fire may have a temperature elevated to at least 1200 degrees Fahrenheit. The high temperature can ignite vaporized fuel, and a container holding the candle may break violently due to uneven

stress on the container caused by the build-up of excessive heat. If the candle has no container, then in the later stages of burning the candle, the excessive heat can melt through the sides and bottom of the candle. Liquid fuel can flow onto and soak into surrounding objects and the candle-supporting surface. The fuel can ignite and combust the fuel-soaked surroundings, and a candle fire results.

[0013] The candle fire and flashover problems are addressed by causing the flame to be extinguished when the pool of liquid fuel becomes shallow. In a freestanding candle with a wick support, the flame extinguishes by making the wick support fuel-impervious, thereby preventing liquid fuel from flowing into contact with the lower end of the wick that is held within the wick support. When the surface of the pool of liquid fuel descends below the top of the wick support, the flame becomes fuel-starved and is quickly extinguished. In this way, the accumulation of excessive heat is eliminated.

(f) BRIEF SUMMARY OF THE INVENTION

[0014] A sheet composed of a flame-resistant material is contacted to a fuel-impervious wick support, and joined to a freestanding candle in proximity to a lower end of a wick. The wick support has a seal that prevents the liquid fuel from reaching the flame by capillary action through the lower end of the wick.

(g) BRIEF DESCRIPTION OF THE SEVERAL VIEWS OF THE DRAWINGS

[0015] Fig. 1 is a view in perspective of the preferred embodiment.

[0016] Fig. 2 is a side view of the preferred embodiment.

[0017] Fig. 3 is a view in section of the preferred embodiment.

[0018] Fig. 4 is a view in section of the preferred embodiment.

[0019] Fig. 5 is a view in perspective of an alternative embodiment.

[0020] Fig. 6 is a side view of an alternative embodiment.

[0021] Fig. 7 is a view in perspective of an alternative embodiment.

[0022] Fig. 8 is a view in perspective of an alternative embodiment.

[0023] Fig. 9 is a view in section of an alternative embodiment.

[0024] Fig. 10 is a view in perspective of an alternative embodiment.

[0025] Fig. 11 is a view in section of an alternative embodiment.

[0026] Fig. 12 is a view in perspective of an alternative embodiment.

[0027] Fig. 13 is a view in perspective of an alternative embodiment.

[0028] Fig. 14 is a view in perspective of an alternative embodiment.

[0029] Fig. 15 is a view in perspective of an alternative embodiment.

[0030] Fig. 16 is a view in section of an alternative embodiment.

[0031] Fig. 17 is a view in perspective of an alternative embodiment.

[0032] Fig. 18 is a view in perspective of an alternative embodiment.

[0033] Fig. 19 is a view in perspective of an alternative embodiment.

[0034] Fig. 20 is a view in perspective of an alternative embodiment.

[0035] Fig. 21 is a view in perspective of an alternative embodiment.

[0036] Fig. 22 is a view in perspective of an alternative embodiment.

[0037] Fig. 23 is a side view of an alternative embodiment.

[0038] Fig. 24 is a view in perspective of an alternative embodiment.

[0039] Fig. 25 is a view in perspective of an alternative embodiment.

[0040] Fig. 26 is a view in perspective of an alternative embodiment.

[0041] Fig. 27 is a view in perspective of an alternative embodiment.

[0042] In describing the preferred embodiment of the invention, which is illustrated in the drawings, specific terminology will be resorted to for the sake of clarity. However, it is not intended that the invention be limited to the specific term so selected, and it is to be understood that each specific term includes all technical equivalents that operate in a similar manner to accomplish a similar purpose.

(h) DETAILED DESCRIPTION OF THE INVENTION

[0043] The utility of the invention is for a freestanding candle having a width of at least two inches, and structural elements of the preferred embodiment are shown in Figs. 1-4. As depicted in Fig. 1, the freestanding candle is a fuel body 12 that has a top surface 7, a bottom surface 13, and an outer peripheral surface 11. The fuel body 12 supports a wick 10. A flame-resistant sheet 14 is joined to the fuel body 12, which has been cut away to show a wick support 16 contacting the sheet 14 and holding the wick 10.

[0044] The sheet 14 is flame-resistant, meaning that the sheet 14 will not ignite when exposed to the flame on the wick 10 and the heat from the flame. The sheet 14 is composed of a material such as metal or plastic, and the thickness of the sheet 14 may vary. The sheet 14 in Fig. 1 is shown circular by a hyphenated line, but

the sheet 14 may have a different form, such as a square shape. Preferably the sheet 14 is the general shape of the pool of liquid fuel that accumulates around the flame in the interior of the fuel body 12. Also, the sheet 14 can serve as a label.

[0045] Fig. 2 shows the wick 10, the wick support 16, and the sheet 14. The sheet 14 preferably extends outwardly at least one inch from the longitudinal axis of the wick 10. The sheet 14 is at least two inches wide, because the effectiveness of the sheet 14 diminishes below a two-inch width. Conversely, the effectiveness of the sheet 14 increases above a two-inch width.

[0046] Fig. 3 is a view in vertical, axial section of the freestanding candle undergoing normal burning, with the fuel body 12. The sheet 14 extends substantially to the outer peripheral surface 11 of the fuel body 12 and may extend all the way to the outer peripheral surface 11. Either way, the sheet 14 should sufficiently cover an area of the bottom surface 13 that corresponds to the pool of liquid fuel, which is shaded in Fig. 3. Figs. 1-3 show that the wick support 16 is contacted substantially in the center of the sheet 14.

[0047] Fig. 4 is a view in vertical, axial section of the preferred wick support 16, which has a barrel 25 mounted upright to a base 27. The wick support 16 is composed of a flame-resistant material like metal, ceramic, or plastic. A bore 21 extends upwardly through the wick support 16, from a bore opening 22 in the base 27 through the barrel 25. The barrel 25 separates a lower end 9 of the wick 10 from the fuel body 12 (not shown). A friction fit holds the lower end 9 of the wick 10 within the barrel 25. A sealant 17 disposed in the bore 21 prevents the liquid fuel

from flowing into contact with the lower end 9 of the wick 10. The sealant 17 may also serve to enhance support of the wick 10 by the wick support 16, when an excess amount of the sealant 17 disposed within the bore 21 contacts and bonds the lower end 9 of the wick 10 to the inside wall of the barrel 25.

[0048] The wick support 16 extends above the sheet 14 a length sufficient to prevent a candle fire, which is at least one-half inch above the sheet 14. The barrel 25 has an increased length, which is an advantage over shorter barrels, because a longer barrel 25 increases the distance the flame is suspended above the pool of liquid fuel. If there is a barrier to the flow of liquid fuel into the base 27 of the wick support 16 and up the wick 10, then, even when the heat from the flame melts the fuel surrounding the base 27, no liquefied fuel can flow into the base 27 of the wick support 16 and up the wick 10 to the flame. As a result, the flame is extinguished when the surface of the pool of fuel falls just below the top of the barrel 25. The longer barrel 25 results in a thicker candle floor once the flame is extinguished and also increases the distance that the wick 10 must curl downward to reach the pool of liquid fuel and cause the dangerously large flame described above.

[0049] The sealant 17 is a compound that resists melting and combusting when exposed to the heat of the flaming wick 10, such as a thermosetting compound or a thermoplastic. The preferred sealant 17 is a flame-resistant hot-melt thermoplastic glue called MACROMELT TPX 16-157, manufactured by Henkel and distributed by Rudolph Brothers and Company, Canal Winchester, Ohio. The sealant 17 also has adhesive properties. The sealant 17 is disposed in the bore 21, at

a position beneath the lower end 9 of the wick 10. The sealant 17 forms a barrier to prevent liquid fuel from flowing into contact with the lower end 9 of the wick 10.

[0050] It is preferred that the sheet 14 is joined to the fuel body 12 at a location in proximity to the lower end 9 of the wick 10, which is held in the barrel 25. In proximity to means that the sheet 14 is lying next to, although it may not be in direct contact with, the lower end 9 of the wick 10. It is most preferred that the wick support 16 is sealingly adhered to the sheet 14. Sealingly adhered means the wick support 16 is bonded to the sheet 14 in a way that prevents the liquid fuel from flowing under the base 27 of the wick support 16, between the base 27 and the sheet 14. The sheet 14 has an adhesive that bonds the sheet 14 to the bottom surface 13 of the fuel body 12, and the adhesive may also serve to sealingly adhere the sheet 14 to the base 27. Alternatively or in addition, an excess amount of the sealant 17, protruding from the bore 21 through the bore opening 22 and onto the sheet 14, may bond the base 27 to the sheet 14.

[0051] Forming the bond between the wick support 16 and the sheet 14 is advantageous to reduce the risk of certain fire hazards. First, bonding the wick support 16 to the sheet 14 prevents the wick support 16 from shifting laterally in the pool of liquid fuel, which would risk bringing the flaming wick 10 into contact with the peripheral wall. Second, bonding the wick support 16 to the sheet 14 is preferred to prevent the wick support 16 from falling over and into the pool of liquid fuel. Third, the bond seals the bore 21 to prevent the liquid fuel from contacting the lower end 9 of the wick 10 held within the barrel 25. Consequently, the insertion of the

sealant 17 into the barrel 25 of the wick support 16 becomes unnecessary, although it is still preferred.

[0052] In an alternative embodiment shown in Figs. 5 and 6, a sheet 114 has a hole through which a barrel 125 is protruded. The edge of the hole preferably forms a tight seal in surrounding contact with the barrel 125. An adhesive may be disposed between the sheet 114 and a base 127 to seal the base 127 to the sheet 114, but this is not necessary, if the tight seal in surrounding contact with the barrel 125 resists being breached by liquid fuel.

[0053] Fig. 7 shows an upper subsheet 80 and a bottom subsheet 90 arranged to form an alternative embodiment shown in Fig. 8. As shown in Fig. 8, a sheet 214 consists of the two adhesive subsheets 80 and 90 contacted together. The arrangement shown in Fig. 7 results in a base 227 layered between the two subsheets 80 and 90, and the upper subsheet 80 has a centrally located hole through which a barrel 225 is protruded. The base 227 becomes layered and unreachable by the liquid fuel that may flow into contact with the upper subsheet 80 by melting through the candle floor during the later stages of burning. However, if the liquid fuel breaches the tight seal formed by the surrounding contact between the edge of the hole through the upper subsheet 80 and the barrel 225, then the base 227 can be sealingly adhered to the bottom subsheet 90 to maintain the preferred fuel-impermeability characteristic. The upper subsheet 80 shown in Figs. 7 and 8 has a smaller area than the bottom subsheet 90 and is circular in form, although the upper

subsheet 80 may have an area as great as the bottom subsheet 90 and may differ in form, such as a square-shaped sheet.

[0054] In an alternative embodiment shown in Fig. 9 a sheet 314 has a peripheral rim 24. The rim 24 has a width and a thickness. The thickness raises and supports the fuel body 12 (not shown) level above a surface upon which the freestanding candle sits. Fig. 9 is a sectional view of the sheet 314 to show the variation in thickness of the rim 24.

[0055] In an alternative embodiment shown in Figs. 10 and 11 a sheet 414 has an alternating thickness. The alternating thickness raises and supports the fuel body 12 (not shown) level above a surface upon which the freestanding candle sits. Fig. 11 is side view with the sheet 414 in section to show a pattern for the variation in thickness.

[0056] In an alternative embodiment shown in Fig. 12 a sheet 514 has an upward flange 34 at the outer boundary. The flange 34 is angled upward relative to the sheet 514. Similarly, Fig. 13 shows a sheet 614 having a flange 44 angled downward relative to the sheet 614.

[0057] In an alternative embodiment shown in Fig. 14 a sheet 714 is corrugated. Fig. 14 shows an example of one corrugation pattern, although the pattern could differ, such as a circular corrugation pattern.

[0058] In an alternative embodiment shown in Figs. 15 and 16 a sheet 814 is dome-shaped. Fig. 15 is a view of the dome-shaped sheet 814, with the fuel body 12 omitted for clarity. As shown by the sectional view in Fig. 16, a cylindrical wick

support 316 is formed continuous with the concave underside of the dome-shaped sheet 814, extending downwardly from a centrally located hole.

[0059] In an alternative embodiment shown in Fig. 17 an enlarged sheet 914 is for a freestanding candle having an enlarged fuel body 212 and more than one wick 110. The sheet 914 of Fig. 17 is adhered to a bottom surface 213 of the fuel body 212. The sheet 914 has a large area and extends substantially to an outer peripheral surface 211 of the fuel body 212, thereby ensuring that any shape of the pool of liquid fuel produced by multiple burning wicks has a corresponding area on the bottom surface 213 that is covered by the sheet 914. Alternatively, Fig. 18 shows that multiple single sheets 915 can be used to obtain the same effect.

[0060] In an alternative embodiment, Fig. 19 shows a sheet 815 imbedded within a cylinder-shaped fuel body 312. Imbedding enhances the aesthetics of the freestanding candle, which consumers often purchase for the variety of shapes and lack of visible structures such as a container or a base. Fig. 20 also shows a freestanding candle having the sheet 715 imbedded within a pyramid-shaped fuel body 412. In Figs. 19 and 20, the sheets 815 and 715 are imbedded near the bottom surfaces 313 and 413 to maximize the amount of fuel consumed by the flame, and therefore the life of the candle.

[0061] Fig. 21 depicts the *in situ* formation of a wick support 416 shown in Fig. 22. First, a wick 210 is contacted upright to a central area on a sheet 615. Second, a flame-resistant agent 18 is disposed on the surface of a lower end 209 of the wick 210 and on the immediately surrounding area of the sheet 615.

Subsequently the flame-resistant agent 18 polymerizes, thereby supporting and sealingly adhering the wick 210 upright to the sheet 615.

[0062] In an alternative embodiment shown in Figs. 23-25, a lower end 309 of a wick 310 is impregnated with a solid flame-resistant agent 118, such as MACROMELT TPX 16-157, to form a wick support 516. The lower end 309 is impregnated in advance, away from a sheet 515, and is then contacted upright to a central region on the sheet 515. Subsequent polymerization of the flame-resistant agent 118 provides support for the wick 310. The solid flame-resistant agent 118 does not create a wider diameter for the wick 310. Rather, the lower end 309 of the wick 310 only becomes sealed by the agent 118 occupying void areas in the lower end 309 of the wick 310, thereby prohibiting capillary action of the liquid fuel through the void areas.

[0063] In an alternative embodiment shown in Fig. 26 a wick support 616 is a block of a solid, flame-resistant material like glass, metal, or ceramic. The wick support 616 sits on a sheet 415 and has a bore 121 extending vertically into the wick support 616 a depth sufficient to hold a lower end 409 of a wick 410. The bore 121 does not extend through the wick support 616, so the bottom of the wick support 616 is solid and impervious to liquid fuel.

[0064] In an alternative embodiment shown in Fig. 27, a wick support 716 is contacted perpendicular to a sheet 315. The wick support 716 is a tube that is mounted upright and sealingly adhered to the sheet 315 by the adhesive already on the sheet 315. Thus, the wick support 716 is impervious to the flow of liquid fuel.

[0065] While certain preferred embodiments of the present invention have been disclosed in detail, it is to be understood that various modifications may be adopted without departing from the spirit of the invention or scope of the following claims.